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FROM THE EDITOR

As most of you have heard by now, Jamestown celebrated its 400th anniversary this year. But among all the various celebrations and events, one very important player in the Jamestown saga may have been left unrecognized — the Atlantic sturgeon. Why should a fish be included in the celebration? Because sturgeon have often been credited with saving the colony from starvation.

And sturgeon have an important story to tell beyond saving the colonists at Jamestown. For centuries, the species was virtually ignored in the bay. But when the massive fish began interfering with commercial fishing gear, fishermen began willfully destroying them. Seen as worthless pests, sturgeon were often tossed ashore to die. Once sturgeon was recognized as a valuable commodity in itself, the species was rapidly overharvested. Now researchers wonder if Atlantic sturgeon can be restored to the bay.

The story of sturgeon may now guide management of another species currently seen as a "pest" along the Atlantic seaboard — the cownose ray. Cownose rays are blamed for consuming commercially valuable shellfish and undermining shellfish restoration efforts along the East Coast. Currently, no market exists for cownose ray and many fishermen are calling for help to control the population. Bob Fisher of Virginia Sea Grant is working to develop a fishery and market for the ray. However, he and other researchers caution that a ray fishery must be carefully managed in order to be sustainable. Rays are slow to mature and give birth to only one pup a year, making them easily susceptible to overharvesting, another characteristic they share with Atlantic sturgeon.

While on the surface the two species appear to have little in common, examining the history and mistakes of the Chesapeake Atlantic sturgeon fishery may inform and guide management of the cownose ray.

— *Erin Seiling*

IN THIS ISSUE

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The Fish That Saved Jamestown

By: Erin Seiling

For thousands of years before the arrival of English settlers, Native Americans used the resources of the Chesapeake Bay and its tributaries for transportation, sustenance and trade.

Sturgeon, which can reach 14 feet or more in length, were an important food source for many tribes. In the Great Lakes region, fishing tribes referred to August as "Full Sturgeon Moon," as that month was the peak of sturgeon harvest. In the Chesapeake, Atlantic sturgeon were fished throughout the spring and summer, the meat cured, stored and rationed for the winter months.

Given their unparalleled size in the bay, catching sturgeon was deemed a right of passage for male tribesmen. Robert Beverley, an important observer of colonial Virginia, published a description of sturgeon fishing in 1705, though his writings refer to an earlier time period.

"[T]he Indian way of catching sturgeon, when they came into the narrow part of the rivers, was by a man's clapping a noose over their tails and by keeping fast his hold. Thus a fish, finding itself entangled would flounce and often pull him under water. Then that man was counted a cockarouse, or brave fellow, that would not let go till with swimming, wading and diving, he had tired the sturgeon and brought it ashore."

The Mariners' Museum Special Collections, Newport News, VA

The First Cash Crop

The English colonists arrived in Jamestown in 1607. Like other colonists and explorers sent before, the men and boys of Jamestown were sent to the New World to discover wealth and riches for

LEFT: This 16th century watercolor from "A briefe and true report of the new found land of Virginia," shows natives fishing for sturgeon, rays, horseshoe crab and a loggerhead turtle. Based on John White's original 16th century watercolors, the etchings included in the book influenced English perception of the New World for many years.

their homeland. Of the 144 men that set sail for the Virginia Colony, between one-third and one-half of them were considered gentlemen. The rest were seamen, laborers and boys, except for the dozen or so skilled tradesmen. Few, if any, had intentions of settling permanently in Virginia. Most hoped to find wealth and return home to England within a year or two. They were not interested in farming and expected the Virginia Company to supply food during their stay. Though earlier explorers recorded an abundance of fish off of New England and the Carolina coasts, evidence suggests that the Jamestown colonists arrived with very little fishing gear.

The hard truth must have hit home when the men arrived in Virginia with few supplies left to sustain them and no merchants to supply them goods. Perhaps inspired by the richness of Virginia's land and waters, the men immediately set to work. A written account of the first day at Jamestown details the men cutting trees, making gardens and constructing nets. It is likely the nets were intended for fishing.

John Smith, perhaps the most famous Jamestown colonist and explorer, kept a journal of his travels in the Chesapeake region. Though Smith readily admitted embellishing the tales, and at times even lying outright, his writings offer insight on the state of the bay during the colonial era. Many of Smith's notes on natural history have been verified by modern science. Smith took note of the fish the colonists found in abundance:

> *"Of fish we were best acquainted with sturgeon, grampus, porpoise, seals [and] stingrays whose tails are very dangerous. Brit, mullets, white salmon, trout, sole, plaice, herring, conyfish, rockfish, eels, lampreys, catfish, shad, perch of three sorts, crabs, shrimps, crayfish, oysters, cockles, and mussels."*

Aside from being a familiar food source, the presence of sturgeon likely excited the Jamestown settlers who knew sturgeon caviar to be a luxury item imported from the Baltic region. There were undoubtedly colonists who thought to make their riches by exporting caviar to England.

Indeed, in the first letter to the Virginia Company in England, the colonists reported, *"our fishing for Sturgeon cannot be less than 2000 pound sterling a year."*

In 1609, Captain Samuel Argall was sent from England to fish for sturgeon in the Chesapeake Bay. There was a discouraging lack of sturgeon caught during his early fishing efforts, but by late summer barrels of pickled sturgeon and caviar were en route to England. However, the products did not fare well and arrived in England spoiled.

> *"[S]turgeon which was last sent came ill-conditioned, not being well boiled. If it were cut in small pieces and powdered, put up in cask, the heads pickled by themselves, and sent here, it would do far better."*

Despite this early failure, John Smith repeatedly urged shareholders of the Virginia Company that the colony should abandon the hope of finding precious metals and minerals and turn to export of other natural resources. In several letters, Smith enumerated the expected costs and returns of exporting cured fish to England.

In 1612, sturgeon became the first North American fishery subject to a reporting system. Apparently, the fishing industry of Jamestown was thriving, even if the export market was not.

> *"All fishermen, dressers of sturgeon, or such like appointed to fish or cure the said sturgeon for the use of the Colony, shall give a just and true account of all such fish as they shall take by day or night…And also all such kegs of sturgeon or caviar as they shall prepare and cure."*

Punishment for non-compliance was harsh

by modern standards. Found guilty of the first offense, the accused would lose his ears, a second offense would warrant a year in the galleys and the third offense earned him three years in the galleys.

It was 1620 before John Rolfe reported to Sir Edwin Sandys that *"the Sturgeon ship… departed hence about the five of July."* Rolfe describes that "great pains" had been taken in fishing to prepare good sturgeon and wrote that by spring, they hoped to be better equipped with cellars and houses to *"do some good therein."*

Caviar was the most valuable product made from sturgeon, but there is also some suggestion other sturgeon byproducts were considered for export as well. Sturgeon air bladders can be used to make a natural gelatin called isinglass. In the colonial period, isinglass was used extensively in the clarification of wine and beer and in confectionary and desserts. Isinglass is still used in British brewing to clarify cask beers. Added to the casks, isinglass pulls live yeast out of solution, "clarifying" the beer for consumption. Isinglass could also be worked into a thin semi-transparent sheet, which was used for carriage windows.

English merchants were eager for the Jamestown colony to develop an export market for sturgeon. One merchant wrote, *"Isinglass worth here 13s. 4d. per 100 pounds and caviar well conditioned is worth £40 per 100 pounds."*

Though it is possible the colonists sent sturgeon air bladders to England to be processed into isinglass, there is no evidence that the colonists tried to make the product in Jamestown.

Even as tobacco took hold as the major export of the colony, many Virginia Company investors continued efforts to establish a profitable sturgeon fishery. In 1623, an investor offered 30 pounds sterling to supply nets to the colony. Despite the interest and investments, the fishery continued to struggle. Records from the General Court of Virginia in 1626 report the sturgeon fishery had cost the adventurers £1700, but "no account of their profit begun."

Dutchman David De Vries, traveling through the colony during this time, believed the trouble to be the climate of Virginia.

> *"[I]t is so hot in summer, which is the best time for fishing, that salt of pickle would not keep them as in Muscovy whence the English obtain many sturgeon and the climate is colder than in the Virginia," wrote De Vries.*

Succulent savior

Over time, the Jamestown settlers abandoned sturgeon as an export commodity, though they continued to rely on it as a source of food.

In little over a month after their arrival in 1607, many of the colonists fell ill and died, likely due to poor sanitation and bad water. Smith wrote that the men were "*plagued with famine and sickness. Only of sturgeon we had great store, whereon we would so greedily surfeit, as it cost many their lives.*"

By the fall, the sturgeon were gone and the colonists were starving. Only the intervention of the "Salvages," as Smith described them, saved the colony that winter. Once recovered, Smith encouraged trade relations with the local Powhatan tribes, thus the colonists gained

Photo courtesy: Walter's Caviar & Seafood, GA

LEFT: Sturgeon caviar is a valuable commodity. Jamestown colonists were hopeful Atlantic sturgeon caviar would become a major export for the colony.

supplies of corn and wild game to sustain them through the first winter. Records indicate that the James River froze nearly from bank to bank and the hungry colonists also collected and ate frozen fish.

In the spring of 1608, the colonists learned to construct fish weirs from the local tribes.

During that spring, Smith undertook several voyages along the tributaries of the Chesapeake Bay, documenting the natural history of the area in vivid detail. On one journey, Smith found

> *"an abundance of fish lying so thick with their heads above the water as for wants of nets...we attempted to catch them with a frying pan... neither better fish, more plenty nor more variety had any of us ever seen...but they are not to be caught with frying pans."*

Later during the voyage, Smith had success spearing fish with his sword and set all of his party fishing, "*[t]hus we took more in one hour than we could eat in a day.*"

Aside from notes on natural history, Smith also related the colonist's dependence on sturgeon as a food souce.

> *"In summer, no place affords more plenty of sturgeon, nor in winter more abundance of fowl, especially in time of frost. There was once taken fifty-two sturgeon at a draught, at another draught, sixty-eight. From the latter end of May till the end of June are taken few but young sturgeon of two foot or a yard long. From thence till the midst of September them of two or three yards long and a few others. And in four or five hours with one net were ordinarily taken seven or eight; often more, seldom less."*

In the spring of 1609, Smith tasked several men with constructing "nets and [weirs] for fishing." During that year, the colonists *"had more sturgeon than could be devoured by dog or man, of which the industrious by drying and pounding, mingled with caviar, sorrel, and other wholesome herbs, would make bread and good meat."*

Given the numerous times John Smith and other colonists wrote of sturgeon saving the settlement from starvation, it is little wonder that sturgeon are sometimes hailed as "the fish that saved Jamestown."

But the men were still without the familiar fishing instruments of England and evidently struggled to adopt the Native fishing techniques or satisfactory methods of preserving the fish, for the winter of 1609 - 1610 became known as "the Starving Time." Only about one third of the colony survived the winter and those that did were undoubtedly looking forward to the spring run of sturgeon for easy food.

For unknown reasons, the sturgeon run in the James River was subject to periods of "lows," when few, if any, sturgeon migrated up the river. If the fish came in the spring of 1610, the colonists were unable to catch them. Giving in to despair, the colonists abandoned the fort to return to England, turning around only after meeting supply ships arriving in the bay. Though other factors surely came into play, the fact that the absence of sturgeon was specifically mentioned as a cause for abandonment clearly indicates the degree to which the colonists relied on sturgeon for food.

Rediscovering a Species

After sturgeon were abandoned as a potential export item in the 1630s, the species was largely ignored. The large fish were often seen as a nuisance that got entangled in nets, destroying fishing gear set for smaller species. Seen as worthless fish, when sturgeon were caught, their bodies were often abandoned onshore to rot. A commercial sturgeon fishery was not pursued again until the late 1800s.

Though the export market for sturgeon failed, archeological evidence from the Jamestown settlement shows sturgeon remained an important dietary staple for the colony. Archeologists working at the historic Jamestown fort have uncovered over 31,000 sturgeon scutes

from excavated middens — or waste dumps. Remains of a sturgeon as long as 14 feet have also been unearthed.

While such sturgeon artifacts provide insight into the daily lives of the colonists, the relics also offer scientists an opportunity to gain information on historic sturgeon populations of the bay.

Instead of scales, sturgeon are protected by rows of scutes — hard, plate-shaped structures that run along the body of the fish. They also possess spines that support their large pectoral fins. Spines and scutes found in the Jamestown middens can be used to determine the age, size and growth rates of the sturgeon consumed by the colony. Spines from Jamestown are being sent to Virginia Commonwealth University for age analysis.

Researchers such as Chris Hager of Virginia Sea Grant use this information to get a better idea of what the sturgeon population of the bay looked like in the 1600s.

"Scute size can be used as a proxy for fish length. Growth increments that show up as rings in sectioned spines reflect cumulative age and annual growth," explains Hager. "The size of whole scutes found reveal how large the sturgeon were during the Jamestown era. Growth increments between successive layers in spines tell us not only how old these fish were but how quickly growth occurred." They also corroborate John Smith's descriptions of sturgeon in excess of two yards in length.

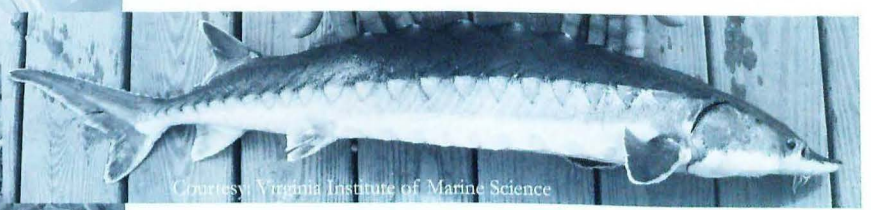
Hager compares the historic sturgeon population to that found in the bay today. "Sturgeon are opportunistic benthic feeders, which means they search the bottom for appropriate food sources and consume whatever is found. Growth ring increment comparisons between James River fish of the 1600s and today can, therefore, be used as an indicator of benthic productivity and system health" says Hager.

Of potentially greater importance, is the drastic decline which has occurred in sturgeon abundance in the bay, and worldwide, since the industrial revolution. Sturgeon belong to a unique and ancient order of fishes, which have survived since the time of the dinosaurs, prospering for millions of years.

"Now only four hundred years after European colonization, the bay's population is on the verge of being declared endangered. Such a rapid decline should really serve as a wake up call. It clearly reflects how dramatically we have and continue to impact our marine environment," Hager adds.

Hager's Virginia Sea Grant research focuses on preserving and restoring the Chesapeake's dwindling sturgeon populations. Jamestown excavation information provides a historic benchmark for the species when it was in relatively "pristine" condition.

"Will we ever see fourteen foot sturgeon in the James again? Probably not in my lifetime, if ever," says Hager, "but knowing that our bay once supported a significant population of such fish, and with proper care could again be home to such natural wonders, isn't that something to work towards?"



ABOVE: Lacking scales, sturgeon are protected by five rows of bony sctues.
LEFT: Scutes excavated from middens at Jamestown. The scutes are analyzed to determine the size and age of the sturgeon the colonists ate.

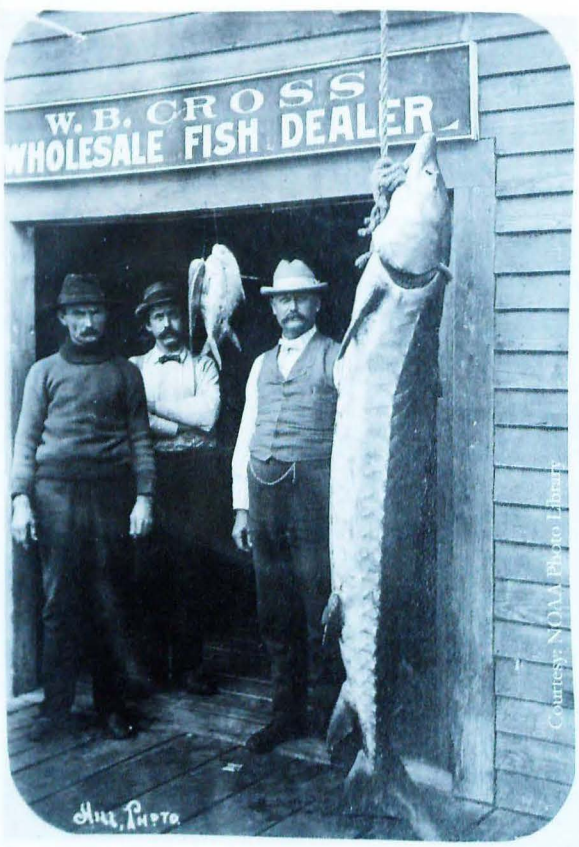
State Of The Sturgeon

Story and Photos by: Chris Hager

Atlantic sturgeon (*Acipenser oxyrhynchus*) were historically very abundant in the Chesapeake Bay, especially in the James River. Captain John Smith claimed there were so many sturgeon in the upper James, that it seemed a man could walk across the river on their backs.

Today, many consider sturgeon a rare fish, in fact the species has been considered virtually extinct in Virginia waters for many years. Two sturgeon species live in the Chesapeake Bay — the shortnose sturgeon (*Acipenser brevirostrum*) and the Atlantic sturgeon (*Acipenser oxyrhynchus*). The shortnose sturgeon, the smaller of the two local species, has been listed as endangered since 1967. Recently, the Atlantic sturgeon has also been suggested for listing under the Endangered Species Act.

It has only been 400 years since John Smith credited sturgeon with saving Jamestown from starvation. What has happened to this once-abundant species?



Courtesy: NOAA Photo Library

From Trash to Treasure

For many decades during the late 18th and early 19th centuries, sturgeon suffered from intentional eradication efforts. Atlantic sturgeon made a significant spawning run in the Chesapeake Bay during April and May, a period that coincided with the large and profitable American shad fishery of the 19th century.

Sturgeon can grow to enormous sizes. DeKay reported an Atlantic sturgeon of 18 feet in length during the 1800s, though the largest scientifically documented specimen was only 14 feet, chronicled by Vladykov and Greenley in 1963. It should be noted, however, that by 1963, Atlantic sturgeon stocks had been severely reduced, and most large fish had been removed from the population.

Their size and sinuous swimming motion make sturgeon powerful swimmers. Their mass overshadows smaller fish in the rivers and easily overwhelms delicate gear set to catch smaller commercial species. Many fishermen during the early 1800s viewed sturgeon as a nuisance, as the fish destroyed nets and gear set for more profitable species, such as shad. Several accounts state that sturgeon were so abundant — and destructive — they were considered worthless pests and, as such, were destroyed in large numbers.

LEFT: Sturgeon were once an abundant and important fishery along the Atlantic coast, as evidenced by this historic photo from Gloucester, Massachusetts.

The shad fishery was a valuable industry in the Chesapeake throughout the late 1800s. During the early years of the fishery, sturgeon caught in shad nets were routinely eaten or simply discarded. As the shad fishery expanded, a commercial value for sturgeon was recognized and a fishery developed. Though historic records do not quantify sturgeon caught as bycatch in the shad fishery, it is probable that intrepid shad fishermen recognized sturgeon as a commercial product unto itself. Once the value of sturgeon flesh and caviar was realized, apathy was replaced by exploitation of the species and the stock was rapidly overharvested. Sturgeon landings in the Chesapeake peaked in 1890, and by 1897, the first significant declines in sturgeon landings were apparent.

The fishery experienced a second major decline in 1901, from which, the stock would not recover. In the thirty short years from 1890 to 1920, Virginia's sturgeon landings declined from 818,000 to 22,000 pounds.

Though historic landings records do not distinguish between shortnose and Atlantic sturgeon, the ease with which these fish were caught is clearly evidenced by the rapid decline in sturgeon population levels. In response to declining population numbers, Maryland enacted a complete closure of the fishery from 1914 to 1923 and Virginia prohibited retention of sturgeon less than four feet long in 1929. In 1974, Virginia prohibited any possession. Despite evidence of dramatic regional decline, a remnant commercial fishery existed coastally into the mid-1990s, producing 100,000 to 250,000 pounds per year. Finally in 1997, a coast-wide moratorium on the fishery was adopted by the Atlantic States Marine Fishery Commission (ASMFC). The moratorium is to remain in effect until there are at least 20 protected year classes in each spawning stock.

Sturgeon have several characteristics that make them susceptible to overfishing and resultant population declines. Sturgeon can live to be 60 to 70 years old and don't begin reproducing until they reach a certain minimum length. Based on observations of Hudson River fish, Atlantic sturgeon males in the Chesapeake are thought to mature at five feet long, around nine years of age, and females at six feet long, between ten and eleven years of age.

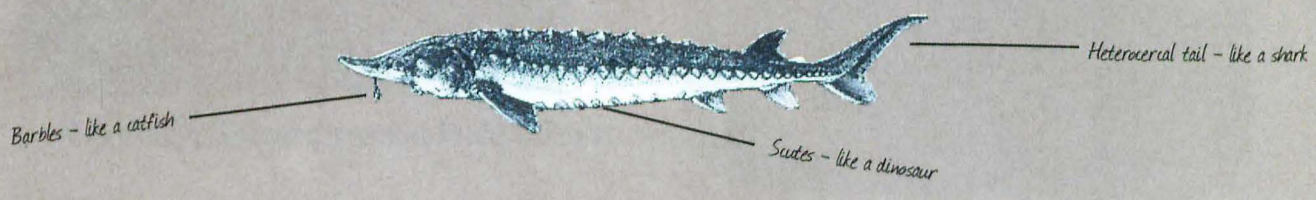
Sturgeon do not spawn every year. Males may spawn every spring or every other. Females go longer between spawning runs. Large females build up an enormous mass of eggs before risking the long and difficult trip upriver to freshwater spawning grounds. It simply takes a long time to consume enough food to have the energy required to produce such an egg mass. When sturgeon populations are healthy, this staggered spawning pattern

One Weird Looking Fish

For those who have never seen a sturgeon it may be hard to imagine what one looks like. The odd looking fish somewhat resemble a cross between a catfish and a shark, though sturgeon are not closely related to either species.

Their vacuum-like mouths are surrounded by barbles, somewhat like those of catfish. Their tails are heterocercal - like a shark. And, in between the two ends, sturgeon are covered by rows of bony scutes instead of typical fish scales. The scutes are reminiscent of dinosaurs, which is appropriate given how old sturgeon are as a species.

Fishes closely resembling sturgeon first appeared during the Upper Jurrasic period, ca. 150 million years ago. To put this in perspective, when sturgeon first appeared, Tyrannosaurus Rex ruled the land.



LEFT: Atlantic sturgeon deposit their eggs on rocky botton habitat in the upper reaches of freshwater rivers.

BELOW: Eroding banks increase the sediment load in the James River, degrading potential spawning grounds.

does not present difficulty, as some portion of the stock spawns every given year. Compounding the spawning scenario is the fact that sturgeon return to their natal rivers to spawn. Therefore, if the spawning population within a given system becomes too small, a mismatch scenario between male and female spawning runs may result.

A River of Challenges

Extermination and overharvesting are not the only anthropogenic influences that contributed to the decline of the stock.

Atlantic sturgeon are anadromous fish, meaning they spend most of their adult life in salt water, but spawn in fresh water habitat, such as the upper James River. Once in fresh water, females seek out hard substrate to which their sticky egg casings can easily attach. Access to fresh water is critical because sturgeon eggs do not survive well in brackish waters. The requirements of freshwater and rocky bottom means sturgeon spawn relatively far upstream. But modern dams and high velocities in inadequate breeches block the progress of many fish headed inland.

Channelization of the upper James during the early 1930s forever altered the fresh water spawning habitats of Chesapeake bay sturgeon. A large section of gravel bottom area near Rockets Landing below Richmond was literally blown up and removed from the river to create a deep water terminal. Further downriver, three oxbows were bypassed and a channel dredged to 33 feet. This not only changed the course of the river — its natural flow, velocities and habitats— but exposed high banks of easily erodable silt. When boats pass through the new channels, wave action washes silt from the banks. These fine particles stay suspended in the water column for awhile, reducing the amount of light and oxygen available for the river's inhabitants. The silt settles out downstream, covering rocky bottom. Such habitat alterations have significantly reduced the quantity and quality of spawning grounds for numerous species. The James historically had the largest Atlantic sturgeon population in the Chesapeake Bay. However, once colonial settlement expanded, so did the sediment impact that degraded the river. Native Americans preserved water quality through horticultural

methods of slash and burn followed by short term use for agriculture. Colonial Virginian's eagerly allotted large areas of land near waterways for permanent agricultural use, increasing sediment load to the rivers. Sediment input in the James remains high today in part due to farming practices and runoff from inadequately constructed developments.

Sturgeon have a peculiar habit of spending time near the surface during their spawning migration. A behavior that intensifies once spawning grounds are reached and is often coupled with jumping. Instances of sturgeon "leaping" into boats were recorded by John Smith and other early explorers. Oral history credits a sturgeon with leaping into the boat of one of George Washington's generals and killing the man from injuries sustained from the massive fish. While the cause of the jumping behavior is unknown, surviving sturgeon do still jump. Given already low population levels, potentially significant numbers of these large fish are struck and killed by boats while in the upper James.

Saving the Species

The Virginia Institute of Marine Science (VIMS) under the guidance of Jack Musick has long been a leader in sturgeon restoration efforts. Chris Hager, Fisheries Specialist at Virginia Sea Grant, joined his efforts and expanded research and restoration efforts within the Chesapeake by forming partnerships between members of the industry, private conservation groups, federal and state agencies and academics.

Most of the field research has been accomplished through the Fishery Resource Grant Program (FRGP) conducted under Hager's guidance. The Fishery Resource Grant Program, funded by the Virginia General Assembly and administered by Virginia Sea Grant, funds collaborative research projects involving the fishing industry and academic researchers. Additional partnerships with VIMS, the U.S. Fish and Wildlife Service, the James River Association, Maryland Sea Grant, Maryland Department of Natural Resources, Virginia Commonwealth University, and the U.S. Army Corp of Engineers have combined resources and funding and expanded FRGP research goals and objectives.

Over the past three years, the FRGP research conducted in large part by local fishermen Kelly Place, George Trice and Jimmy Moore has collected much needed information on sturgeon bycatch, age structure, and ge-

netic composition. Information on bycatch parameters such as catch per unit effort and mortality are crucial in keeping Virginia's fisheries active while preserving species like the Atlantic sturgeon that have undergone drastic population declines. Understanding age structure and composition is critical to effective management, especially when regional populations may consist of fish from various spawning stocks.

Pectoral spines collected by the researchers are sent to Virginia Commonwealth University for age structure analysis and genetic information. Age analysis indicates that at present, most fish inhabiting the bay are younger than six years old. These young fish need to be protected for at least seven more years before they will contribute to the spawning population of their species.

DNA analysis indicates that there are five genetically unique spawning stocks along the Atlantic coast, including one unique to the Chesapeake Bay. This is an exceptionally important finding because genetic diversity within the population must be maintained for long-term survival of the species. Regionally it is possible that genetically distinct spawning stocks could be listed separately under the Endangered Species Act (ESA). For example, if sturgeon of Hudson River origin — another unique genetic stock — are relatively abundant and those of Chesapeake origin are rare, regulators could list the Chesapeake stock under the ESA and while Hudson fish are not listed. This presents an enforcement problem however, because both stocks mix in the Chesapeake.

To date, FRGP projects have tagged over 600 fish. Tracking the recaptures of tagged fish has vastly ex-

Today, sturgeon populations exist only in the northern hemisphere and evidence vast declines in abundance and diversity due to human influences. Ten sturgeon species remain in America, two of which occur in the Chesapeake Bay and its tributaries.

The two bay species, the shortnose sturgeon (*Acipenser brevirostrum*) and the Atlantic sturgeon (*Acipenser oxyrhynchus*), have common characteristics:

- They are long lived (60-70 years).
- They experience rapid growth during early years.
- They feed on similar low level benthic taxa (eg. worms, snails, small shellfish and fish).
- They use deep channel habitats for all life stages.
- They have complex seasonal migration patterns with distinct seasonal concentration areas.

OPPOSITE PAGE: The Virginia Fishery Resource Grant Program partners commercial fishers with academic researchers to acheive top-notch research.

THIS PAGE: Fish are tagged (left) and then acoustically tracked (above, right) to determine the movements of Atlantic sturgeon during all stages of life history.

panded what was previously known about sturgeon movements within the bay and along the coast.

FRGP has also provided information and specimens for various related investigations. Such projects have investigated bycatch parameters, such as bycatch in the striped bass gill net fishery, identification of sturgeon bycatch hot spots and the survival rates of sturgeon taken as bycatch. Cooperative investigations focused on minimizing sturgeon entanglement and reducing mortality of entangled fish through gear modifications are currently underway.

FRGP efforts have supplied mature fish to Maryland Sea Grant and the Maryland Department of Natural Resources who are rearing juveniles and examining the potential for restocking the bay. Regulations mandate that stocking must be accomplished with fish of Chesapeake genetic stock.

Adult fish have also been used for Virginia Sea Grant/VIMS tracking investigations, with the ultimate goal of identifying remaining spawning sites in the James River. Side scan sonar images from the Appomattox and upper James Rivers have been collected and will be used to map the riverbed and identify potential suitable spawning habitat. Quantifying and qualifying remaining essential fish habitat will guide future restoration efforts.

Some of the most recent research conducted has been done in cooperation with the Army Corp of Engineers. This entity is charged with maintaining a deep water channel to Richmond — a goal that puts the agency and its dredges in direct contact with sturgeon of various age classes along the river's length. Research has thus far focused on identifying a sonic signature unique to sturgeon that could be used during dredging operations to reduce interactions. Future research will complement ongoing efforts and identify temporal patterns of habitat use and extent of habitat destruction due to dredging.

ABOVE: Chris Hager releases a small Atlantic sturgeon into the James River. Hager's research indicates that sturgeon this small are likely native to the Chesapeake Bay, as small fish stay in their natal rivers several years before migrating along the coast.

Sturgeon studies are ongoing, as much about the species is remains unknown. The partnerships Virginia Sea Grant has formed are crucial to gathering the baseline data needed to inform management decisions. With continued funding for research and restoration efforts, Atlantic sturgeon may not only be preserved, future generations may once again reap the benefits of a profitable sturgeon fishery.

Everybody Loves Ray?

Story by: Bob Fisher & Dean Grubbs

Photos by: Bob Fisher

Clams, oysters and scallops — it sounds like any shellfish lover's dream dinner menu. But these delectable items also constitute the preferred diet of the cownose ray. And eat they do — cownose rays are described as having nearly insatiable appetites. Fishermen often blame the rays for wiping out aggregations of commercially valuable shellfish. Fishermen are understandably upset when such potential revenue ends up as dinner for the rays. Unlike the shellfish they consume, there is currently no commercial market for cownose ray, leading many to view the species as a nuisance and a pest, though researchers at Virginia Sea Grant are working to turn that perception around.

ABOVE: Cownose rays are plentiful in the Chesapeake Bay during the summer months. Researchers at Virginia Sea Grant are working to develop a fishery for this underutilized species.

Behavior in the Bay

Cownose rays (*Rhinoptera bonasus*) begin converging on the Chesapeake Bay in early May. They are at peak abundance during June through September, then leave the bay in October, returning to wintering grounds off the Florida coast. Cownose rays are routinely observed traveling in schools. The largest school of cownose rays recorded was a single school of more than five million individuals covering more than 1,100 acres.

Studies have shown that the dominant prey of cownose rays are small, weak-shelled bivalves. Concerns over predation on commercial bivalve resources – such as oysters (*Crassostrea virginica*) and hard clams (*Mercenaria mercenaria*) in the bay – have been raised by fishery and aquaculture operations for many years.

Smith and Merriner (1987) investigated the diet of cownose rays caught in the Chesapeake Bay during the summers of 1976 —1978. Most rays were captured over shallow sand and mud flats in the lower York River. Sample sizes were very small, but the three dominant prey items found were soft clams (*Mya arenaria*), Baltic macoma clams (*Macoma balthica*) and stout razor clams (*Tagelus plebeus*). The remains of oysters (*C. virginica*) were only found in one stomach and hard clams (*M. mercenaria*) were identified in three stomachs. However, no samples were collected from areas of known oyster beds. Soft clam populations in the bay have declined since the 1970s however and there is concern that cownose rays have shifted to feeding primarily on commercially valuable oysters and hard clams instead.

The maximum reported bite force of an adult cownose ray is 200 Newtons (N) (Sasko et al). According to research conducted by Bishop and Peterson (2006), the force necessary to crush the shell of native Eastern oysters (*C. virginica*) is greater than 200 N for oysters over 1.18 inches (30 mm) shell height, suggesting only very small oysters are susceptible to predation pressure by cownose rays. Interestingly, the force required to crush the Suminoe oyster (*Crassostrea ariakensis*) is below

200 N at all sizes. The Suminoe oyster is currently being considered for introduction to the bay. Research suggests that this species will be highly susceptible to predation by cownose rays at all sizes, which could hinder establishment efforts.

Cownose rays are known to forage in groups. Studies in North Carolina have shown ray aggregations to be capable of depleting dense patches of clams and bay scallops. Research on eagle rays found feeding behavior to be independent of the density of the clam, *Macomona lilliana*, at low clam densites. However, a distinct threshold density of clams was found that elicited a stark increase in the foraging behavior of rays. Rates of clam mortality and habitat disturbance in high density areas were nearly three times higher than in low density areas. Similarly, Peterson et al. reported cownose rays selected high density patches of bay scallops in the lagoons of North Carolina on which to feed. These examples suggest clams and scallops are less susceptible to predation at low densities, which could act to stabilize their populations against ray predation.

In addition to eating mass quantities of shellfish, the feeding behavior of cownose rays is known to damage large areas of submerged aquatic vegetation, or seagrass. After finding a food source, the rays lay near the bottom, vigorously pumping their wings to excavate prey from the substrate. This behavior uproots sea grass beds, which are used as juvenile habitat by many bay species. Seagrasses also help filter runoff, pollutants and sediment from the water column, making them an integral part of bay health. In 1975, schools of cownose rays were documented as "inflicting severe damage" to submerged aquatic vegetation in the lower York River. Several groups are working to restore and reestablish seagrass beds in the Chesapeake Bay and the potential for disturbance from schools of cownose rays is a concern.

Studying the Species

Since 1972, shellfish growers in Virginia have solicited political and academic assistance to control ray predation, advocating either utilization or eradication of the species. Bob Fisher, Fisheries & Seafood Technology Specialist with Virginia Sea Grant, has led efforts to market the ray for human consumption and as bait for other fisheries since 1990. As these are new markets, profit margins are negligible and fishermen have not found the harvest of rays to be economically viable.

However there is renewed interest in controlling the rays, as recent large-scale oyster restoration efforts throughout the bay have been compromised due to cownose ray predation. Traditional pound net and haul seine harvesters have indicated an interest in participating in this effort. This newfound interest from the harvesting sector represents a foundation level lacking in previous efforts. Establishing a viable market for cownose ray would have a twofold benefit for Virginia watermen. First, harvesting cownose rays from the waters would lessen their impact on shellfish fisheries and second, a cownose ray fishery would provide a new source of income for local fishermen.

Since the 1970s, Virginia Sea Grant researchers have focused on developing both the ray fishery and marketable ray products. Studies have reported on the social behavior and diet of the rays, important components of developing a viable fishery for the species. Cownose rays are elasmobranch fishes, meaning they are closely related to skates and sharks. Like other elasmobranchs, cownose rays are characterized by slow growth, late maturity and low reproductive rates. Male cownose rays in the bay mature at five to six years old, while females mature at seven to eight. Females gestate for 11 to 12 months, giving birth to one live pup. Any management strategies for the cownose ray must take into account this life history, which makes the species highly susceptible to overexploitation.

LEFT: Bob Fisher processes cownose ray into filets.

BELOW: Cownose ray has a beefy texture but bland flavor. The meat holds marinade well and cooks quickly which could make it a favorite among chefs.

In 2001, projects funded through the Virginia Fishery Resource Grant Program (FRGP) focused on using portable nets to remove rays from shellfish growing areas and exploring various bait markets for cut ray products. A subsequent FRGP project in 2005 initiated population estimates, harvesting and processing methods and market acceptance of ray products for bait and human consumption. The Fishery Resource Grant Program, funded by the Virginia General Assembly and administered by Virginia Sea Grant, funds collaborative research projects involving the fishing industry and academic researchers. Projects funded by Virginia Sea Grant and the Virginia Marine Resources Commission in 2006 and 2007 provided additional biological assessment information as well as the most extensive educational and marketing efforts to date.

The culmination of all of these efforts has been to create a collaborative atmosphere between and among various stakeholders. In addition, Virginia Sea Grant has built a reputation as having a comparative wealth of knowledge on cownose rays. As such, the office has fielded information requests from other states experiencing ray predation problems. One of the largest clam aquaculture production sites in the U.S., out of Cedar Key, Florida, recently contacted Virginia Sea Grant for information on controlling cownose ray predation.

Ray predation has become a regional issue. Rays have hindered bay scallop restoration efforts in North Carolina and have been identified as severe predators on oysters and clams in commercial sites in Maryland and New Jersey. Virginia Sea Grant hosted a regional workshop on cownose rays in June 2006 to facilitate information exchange among various research groups, regulatory agencies and the fishing industry. Representatives from North Carolina, Virginia, Maryland and New Jersey presented information including historical and current information on ray biology, predator control methods, ray impacts on shellfish and submerged aquatic vegetation, ray harvesting and processing methods, and ray product development efforts. The potential to establish a responsible ray fishery was also addressed and research and extension needs identified.

Current FRGP research, in collaboration with Virginia Sea Grant, is focused on the

Cownose Ray featured during VIMS Marine Science Day

Cooking demonstrations and hands-on preparation of cownose ray were included in the activities for the annual VIMS Marine Science Day on May 19. The kitchen opened in the morning to kids and parents eager to learn about the cownose ray and to make and sample a "Stingray Roll-Up," made of sautéed ray meat and vegetables, rolled in a flour tortilla.

Later in the day, over 50 people attended a scientific and culinary program focusing on the cownose ray. Virginia Sea Grant seafood scientist, Bob Fisher, described the ray's biology, ecology, and the cownose ray research he is conducting. Marine education specialist Vicki Clark demonstrated an easy summer salad incorporating cownose ray. For the finale, ray strips were breaded or battered using a variety of different seasonings, and participants lined up for a taste test.

collection of pertinent biological information, development of a cownose ray fishery and market development and penetration for ray products. Rays were harvested in Virginia waters from May through October 2006 for biological and marketing assessment.

Six FRGP-funded commercial fishermen harvested rays by haul seines and pound nets from sites along the western shore of the Chesapeake Bay. Harvesting areas included Lynnhaven, Poquoson Flats, York River, Mobjack Bay, Reedville, and the Potomac River. A total of 626 cownose rays were harvested and processed at a commercial seafood plant in Hudgins, VA and at the Virginia Institute of Marine Science (VIMS). The collected rays were used to establish the relationship of age to length/weight, embryonic development, and size at sexual maturation. Stomach contents were also analyzed for prey item components and percentages. Such biological information is needed to determine the sustainability of a fishery.

Preliminary stomach content analyses suggest a large part of the ray diet is fish. However, this could be an artifact of the harvesting method, where gilled fish in haul seines and pound nets are easy prey and attract rays which become entangled in the nets. Fishery-independent capture of rays is needed to more thoroughly investigate the diet of cownose rays.

After biological information was gathered from the collected rays, the individuals were processed for marketing efforts. Rays were either cut by hand or a band saw to provide three basic market forms for human consumption trials: whole wings, fillets and "loins", which are a wide "steak-cut" through the thickest area of wing. The resulting ray products were used by the Virginia Marine Products Board and researchers at VIMS for market trials and seafood educational seminars.

Marketing trials using fresh ray meat were conducted throughout the summer of 2006. Various ray market-forms were distributed fresh from the processing plant to chefs around the state for culinary evaluations. A ray fact sheet and product survey accompanied each shipment of ray. The chefs were asked to work with the ray product, test preparation methods, and if so desired, include ray items on their menu. To date, 54 restaurants have participated, out of which 35 restaurants had positive responses and 12 had negative responses to the product. Seven restaurants requested a second order for promotional purposes. 1,830 pounds of product were also put into commercial frozen storage for marketing use when fresh ray was not available

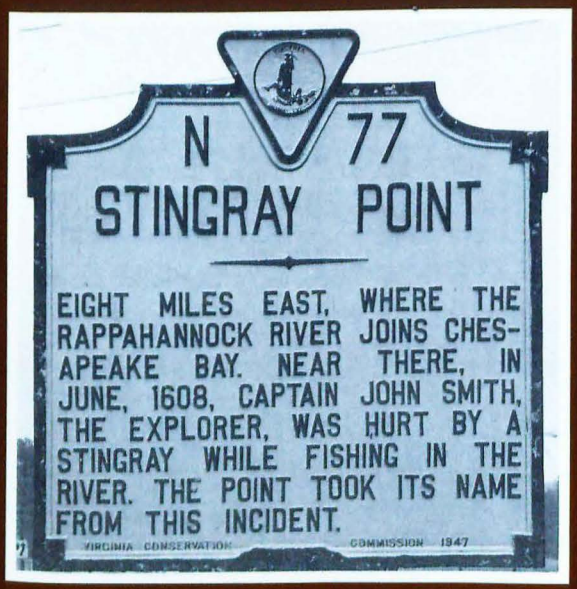
Additional cownose ray products are also being evaluated. Skins from the dorsal and ventral sides of the ray wings were removed, treated with salt and shipped to a tannery specializing in marine species for evaluation. Preliminary evaluations suggest the cownose ray skin is similar to marketed ray skins in Asia. Liver samples were sent to a certified lab for oil content and fatty acid profile analysis. Results

from these samples are promising, with ray oil having the potential to be comparable to commercial shark liver oil.

But developing a market for cownose ray products is only part of a long-term solution. Commercial shellfish harvesters and shellfish aquaculturalists are primarily concerned with reducing or eliminating ray predation on shellfish resources. A study at VIMS used magnetic fields as a means to exclude rays from sensitive shellfish areas with positive results. Elasmobranchs, such as sharks and rays, have sensory pores along their head region which are used to detect weak electrical fields. Cownose rays, like other elsamobrachs, use these fields to locate and capture prey. VIMS researchers used magnetic fields generated by rare earth magnets and electropositive metals to successfully cause irritation to the sensory organs, which resulted in the rays actively avoiding the areas. In a series of trials involving magnets and specific alloys placed near bait (immobilized blue crab), the bait was never investigated or eaten, while unprotected bait was readily fed upon. These repellant devices do not harm the rays, only discourage individuals from entering a certain area by causing a slight irritation. Other fish species that are not able to detect the fields are not affected by the devices.

Proposed work for summer 2007 includes the collection of fishery-independent biological samples to supplement fishery dependent samples of 2006, primarily for diet analysis. Researchers also hope to conduct experiments with captive rays held at VIMS. One aspect under investigation is determining what size ray can successfully feed on what size clam/oyster. Investigation of behavioral responses to electromagnetic fields continues as well.

Prior efforts to utilize the cownose ray have been limited due to lack of industry support, political involvement, and poor consumer education and marketing efforts. However, marketing and education efforts by Virginia Sea Grant over the past five years have provided the foundation for the renewed market interest. Coupled with awareness among the fishing community, media coverage of shellfish restoration efforts foiled by cownose rays has introduced the issue to a larger public community. The idea of a cownose ray fishery is now embraced by many involved, who see the potential to reduce predation on valuable shellfish species while developing an alternate fishery that will support Virginia watermen. However, researchers caution that a large-scale fishery will not be sustainable. High fishing pressure in the cownose ray fishery in Brazil has resulted in larger declines in the ray population, which is currently listed as "Endangered." Instead of a nuisance, the cownose ray should also be viewed as an underutilized species that warrants consideration as a renewable fishery resource if properly and carefully managed.



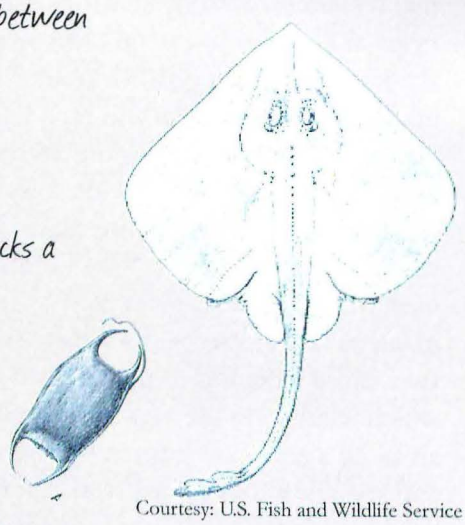
John Smith became acquainted with rays during his journeys in the Chesapeake. Once, while fishing, Smith happened to spear a ray. In trying to remove the ray from his sword, he was stung in the forearm by the "poisoned sting of two or three inches long." Within hours, Smith's hand, arm, shoulder and part of his body had become so swollen and painful, the men feared he would die and even dug his grave. Smith recovered from the sting however, ate the ray for dinner and named the nearby land "Stingray Point."

Bob Fisher of Virginia Sea Grant says the ray speared by Smith was most likely a cownose ray based on the abundance of cownose rays in the bay during the summer months when Smith was stung.

Naturalist's Corner

Skates & Rays

Skates and rays can be difficult to differentiate. Both are flat, diamond-shaped, bottom dwellers with long, thin tails. But there are a few notable differences between the species.



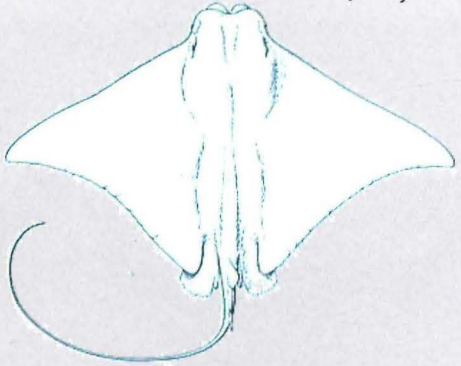
Courtesy: U.S. Fish and Wildlife Service

Skates

- The tail of a skate is relatively thick and stocky and lacks a stinging spine.
- The tail generally has small fins near the tip.
- The pelvic fins (near the base of the tail) are two-lobed.
- Young hatch from egg cases. Beachcombers often refer to the washed-up cases as "mermaids purses."

Rays

- The tail is relatively thin and whip-like and contains a stinging spine at its base.
- The pelvic fins are single-lobed.
- Give birth to live young called "pups."



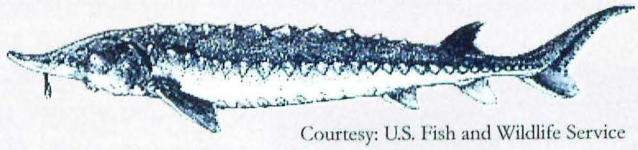
Courtesy: U.S. Fish and Wildlife Service

Another general characteristic distinguishing the two is the flesh of the species. Skates typically have white, flaky flesh when cooked. In fact, skate is often used to make traditional English fish and chips. In contrast, many ray species, such as the cownose ray, have red, beefy meat.

Sturgeon

There are two sturgeon species that spend time in the Chesapeake Bay, the Atlantic sturgeon and the shortnose sturgeon. Though closely related, several characteristics distinguish the species.

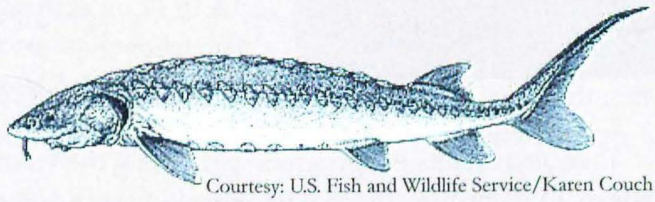
Atlantic Sturgeon



Courtesy: U.S. Fish and Wildlife Service

- Larger of the two bay species.
- Has longer snout, but smaller mouth.
- Anadromous, meaning it spends most of its adult life in salt water but spawns in fresh water habitat, such as the James River.
- Scutes appear sharp and are present on younger specimens.

Shortnose Sturgeon



Courtesy: U.S. Fish and Wildlife Service/Karen Couch

- Smaller of the two bay species.
- Shorter snout, but larger mouth.
- Smoother appearance.
- Lack of scutes in front of and immediately above the anal fin base.
- Amphidromous, meaning it spends nearly its whole life in fresh water, making occasional periodic runs into higher salinity areas.
- Listed as federally Endangered Since 1967.

National Sea Grant Graduate Fellows

In 1999, the National Sea Grant Office and NOAA Fisheries established a graduate fellowship program for Ph.D. candidates focusing on population dynamics or marine resource economics. The goals of the fellowship program are to: increase expertise in these two fields, foster working relationships between academic scientists and NOAA Fisheries and provide real-world experience to graduate students, helping to further enhance their careers.

Two students at the Virginia Institute of Marine Science (VIMS) recently completed population dynamics fellowships and share their experiences here.

Thomas Ihde, advised by Dr. John Hoenig, developed, tested and applied new abundance estimation methods for use in fisheries stock assessment. Ihde's new models, based on "index-removal," offer important advantages and provide a valuable alternative to previous, more complex models. Ihde applied his new abundance estimation models to Tasmanian rock lobster populations and the models appeared to work well. "These methods can be applied to many other fisheries as well," says Ihde. He suggests that his models could be used to "double-check" population estimates produced by other models.

The fellowship requires one scientists from NOAA Fisheries to sit on each student's Ph.D. committee. Ihde had two. "The fellowship was a great opportunity," says Ihde. "Just working at the NOAA labs and meeting the people [was] an excellent experience," he says.

Ihde also credits the program with giving the fellows the opportunity to get "boat time." Ihde explains that people that working in fishery population dynamics come from a wide array of backgrounds, some have a field biology background, but many do not. In fact, many the field started in mathematics, says Ihde. Not everyone has had the opportunity in undergraduate or master's programs to be aboard vessels doing research. A first-hand understanding how population surveys are actually performed is critical to understanding the assumptions inherent in model building, says Ihde.

An additional benefit of the fellowship program, Ihde mentions, is an annual meeting where all the fisheries population dynamicists and economists get to meet and interact. "It sounds cliché, but you really get to learn about the cutting-edge research at those meetings," says Ihde. The meetings provide the fellows feedback on their work from the top researchers and the next generation of fisheries modelers, and they hear about the newest ideas and efforts happening in fisheries modeling, he adds.

Ihde has just begun a post-doctorate fellowship program with the Chesapeake Biological Lab where he will work on project "Fish Smart."

John Walter, also advised by Dr. John Hoenig at VIMS, also advised by Dr. John Hoenig at VIMS, worked to incorporate aspects of space into stock assessments of sea scallops and oysters. Walter use geostatistical methods to incorporate geographic information into statistical treatment of fisheries data. Such advanced statistical methods are used in estimating how fish are distributed.

Walter's methods of spatial analysis make a vast amount of data collected onboard commercial fishing vessels available as input for management decisions. In conjunction with vessel monitoring systems and onboard observer data collection, model-based prediction methods provide an integrative framework for real-time, cost-effective incorporation of data collected by vessels during in the normal course of fishing.

Working closely with NOAA Fisheries scientists at Woods Hole, Massachusetts and Beaufort, North Carolina, Walter developed and applied these methods to the North Atlantic scallop fishery.

Walter describes the fellowship as "research and development for the future." "You get exposure to the inner workings of the assessment process, but the actual research that you do can range from the purely practical to something ahead of its time – it is an investment in the future," says Walter.

Walter encourages any student with excellent quantitative skills and an interest in ecological problem solving to apply to the fellowship program. "The science that we do integrates our biological knowledge of a species with what we know about the fishery to provide the best advice for sustainable fisheries management. It is challenging, but it really is one of the most critical parts of the management process."

Walter is now employed as a Fisheries Scientist by the Southeast Fisheries Science Center in Miami. "I am excited to be able to apply the skills that I developed during my fellowship years to [new] fisheries," says Walter.

In addition to Ihde and Walter, who have completed their Fellowships, a new Fellow recently began Population Dynamics work. **Robert Leaf**, Ph.D. candidate in the Department of Fisheries and Wildlife Science at Virginia Tech will be investigating the effects of fishing on genetic diversity in wild populations under the direction of advisor, Dr. Yan Jiao. Look for updates on Leaf's progress throughout the duration of his Fellowship.

Population dynamics fellowships provide three years of funding. Marine Resource Economic fellowships provide two years of funding. If you are interested in learning more about these, and other fellowship opportunities available through Sea Grant, contact Cynthia Suchman, Assistant Director of Virginia Sea Grant (*csuchman@vims.edu*).

Sea Grant

NOAA NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION U.S. DEPARTMENT OF COMMERCE

Knauss Fellows

Three graduate students from the Virginia Institute of Marine Science (VIMS) are spending 2007 in Washington, D.C., as Sea Grant Knauss Marine Policy Fellows. This prestigious fellowship provides graduate students in marine fields the opportunity to work in the legislative or executive branches of the federal government for a year.

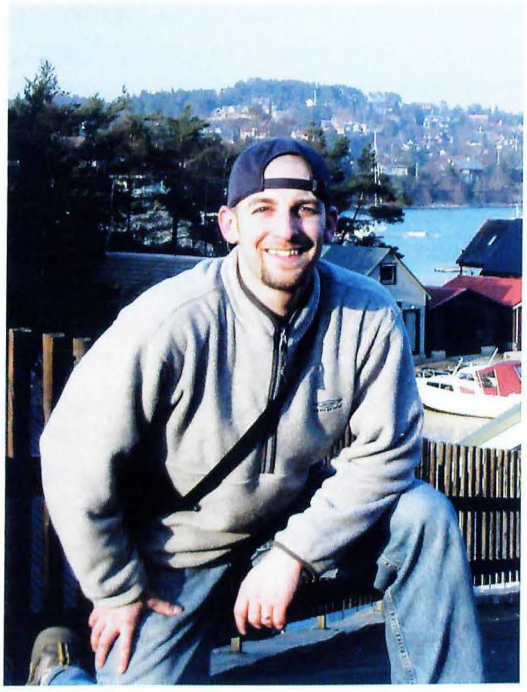
Lenny Pace, M.S. in Fisheries Science from VIMS, is spending 2007 as a marine program liaison between the U.S. Fish and Wildlife Service (FWS) and the National Oceanic and Atmospheric Administration (NOAA), and splits his workweek between Arlington, Virginia (FWS) and Silver Spring, Maryland (NOAA). Pace says, "I'm loving the exposure to multiple offices," despite the challenges of his commute, and feels that the Knauss fellowship complements his graduate training in science. He adds, "The fellowship is a great learning experience and first step toward a career in management."

Pace serves as part of the Secretariat of the U.S. Coral Reef Task Force and is busy preparing for a task force meeting in American Samoa this summer. He is also writing outreach materials outlining the role of FWS in coral reef and coastal environments, organizing tasks for scholars who will be working with the Coral Reef Task Force and FWS this summer, attending relevant Congressional hearings on Capitol Hill, and preparing presentations for an Assistant Deputy Secretary of the Interior (DOI) on the DOI's ocean role. Pace is also looking forward to attending the 8th International Conference on Mediterranean Coastal Environments in Egypt this fall to learn more about integrated coastal zone management and global coastal systems and conservation.

Matt Strickler, pursuing a double Masters in Marine Science and Public Policy at VIMS, is a Knauss Fellow with NOAA's Office of International Affairs. His efforts have been directed toward a variety of international trade and environmental issues and he describes his fellowship experience thusfar as "a good mix of independent and team projects." His group is responsible for vetting language relating to the environment in free trade agreements and work plans. In addition, he's been involved with the Whitewater to Bluewater Initiative, a joint venture with the State Department to build a network of environmental organizations, governments and the private sector to promote sustainable development goals in the Caribbean. Sustainable tourism is one focus of NOAA's efforts and Strickler recently attended the annual meeting of the Caribbean Tourism Organization, held in Grand Cayman this year. He notes that the conference was particularly

valuable because he heard new perspectives on sustainable development issues and environmental hazards.

Within the next few months, Strickler plans to travel to New York to observe the United Nations Open Ended Consultative Process on the Law of the Sea. He also hopes to participate in a trip to Morocco, where NOAA is negotiating a Memorandum of Understanding with that nation on capacity-building initiatives for coastal zone management and remote sensing.



Paul Bradley, a Ph.D. candidate in the Physical Sciences Department at VIMS, is working in NOAA's Office of Legislative Affairs this year. His duties focus on facilitating exchange of information between the United States Congress and NOAA scientists and managers. For example, Bradley routinely coordinates and conducts briefings with Congressional staff on a wide variety of issues, including aquatic invasive species, nutrient pollution, climate change education, and Great Lakes research. He has also helped NOAA employees prepare to present testimony at Congressional hearings. Currently, Bradley is trying to raise Congressional awareness of NOAA's efforts in the areas of harmful algal blooms (HABs) and hypoxia through meetings with members from coastal states and plans to keep his scientific knowledge current by attending a HAB workshop in Woods Hole this fall, as well as the Estuarine Research Federation's bi-annual conference in Providence.

Bradley is enjoying his role as science-policy liaison. "This is exactly the type of position I was looking for when I applied for the fellowship," he explains. "It helps to have a solid science background because it gives me confidence in my ability to understand and communicate scientific material to a more general audience."

The Knauss Marine Policy Fellowship is open to graduate students attending U.S. universities in marine-related fields. Detailed information is available through NOAA's National Sea Grant Office website: *www.seagrant.noaa.gov/knauss/*. Applications from Virginia students should be submitted to Virginia Sea Grant (*www2.vims.edu/seagrant/*), with spring deadlines for the following fellowship year. Graduate students or faculty in Virginia who are interested in learning more about the this opportunity and the application process are encouraged to contact Virginia Sea Grant's Assistant Director, Cynthia Suchman (*csuchman@vims.edu*).

News from the Point

Wendy Larimer has been hired as the Marina Technical Advisory Specialist for the Virginia Sea Grant Program at the Virginia Institute of Marine Science (VIMS). This full-time position became available after the General Assembly allocated funding for Virginia's expanding Clean Marina program. The purpose of this position is to oversee Virginia's Clean Marina program, addressing the social, economic and environmental needs of the marina industry, while providing education as to the importance, sustainability and management of our marine environment and resources.

Larimer last worked for the City of Wilmington, NC. She was the city's liaison to a variety of private and public organizations and citizens, managed the city's docking program and created new programs and policies to enhance safety in and beautify the historic downtown area.

Previously, Larimer was with NC Marine Trades Services as a regulatory consultant. During this time she started NC's Clean Marina program, wrote the state's BMP manual for marinas, co-edited the monthly publication *Tradewinds*, and coordinated the annual NC Marine Expo.

Larimer has also worked as a marina manager, grant writer for pump out installations, and a marina permitting specialist, taking her from Rhode Island to South Carolina, Maryland and North Carolina. She has an MA in Marine Affairs from the University of Rhode Island and BA in English from Hartwick College.

New Publications

Two new publications are available from Virginia Sea Grant.

- Virginia Shellfish Aquaculture – Situation and Outlook Report (Results of Virginia Shellfish Aquaculture Crop Reporting Survey 2005-2007). By Tom Murray and Mike Oesterling. Available online as a .pdf document: *www.vims.edu/adv/aqua/MRR2007_2.pdf*

- The Use of Bait Bags to Reduce the Need for Horseshoe Crab as Bait in the Virginia Whelk Fishery. By Robert Fisher and Dylan Fisher. Available online as a .pdf document: *www.vims.edu/adv/fisheries/MRR2006_10.pdf*

For hard copies of these and other reports, contact:
Sea Grant Communications
Virginia Institute of Marine Science
P.O. Box 1346
Gloucester Point, VA 23062
804/684-7170

Upcoming Events

The **Virginia Aquaculture Conference** is scheduled for November 16 & 17, 2007, in Williamsburg Virginia. The conference is designed for those already in the aquaculture industry and those who are considering starting an aquaculture business. It will provide an opportunity to learn about current or upcoming issues, new developments in culture technology and to interact with others of similar interests. In addition, a trade show will accompany the program, providing direct contact with aquaculture supply vendors. Both shellfish and finfish culture activities will be addressed during the two-day program, as well as topics of interest to both groups, such as marketing and financial resources.

The conference is organized by a multi-disciplinary group, including Virginia Sea Grant, the Virginia Department of Agriculture and Consumer Services, Virginia Farm Bureau Federation and the academic institutions of Virginia Tech, the College of William & Mary's Virginia Institute of Marine Science and Virginia State University. Members of aquaculture industry groups, such as the Virginia Commodity Committee of the Virginia Farm Bureau will assist in the development of the agenda to ensure timely topics are included.

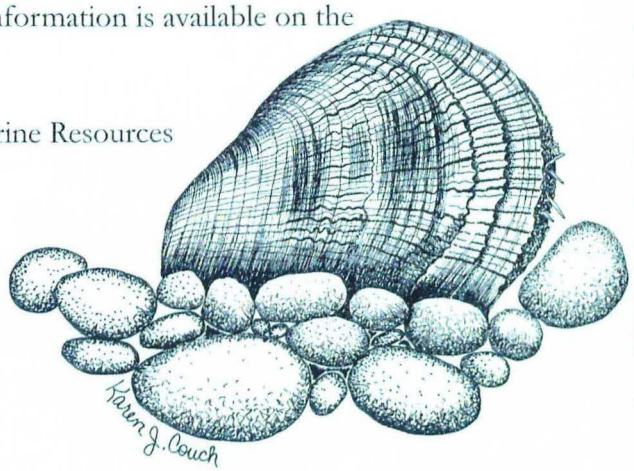
Conference registration is $50. To register online, visit *www.wm.edu/conferenceservices/*. On the left menu, scroll over to "Conference Registration," click on "Virginia Aquaculture Conference." For more specific questions contact:

Mike Oesterling, Virginia Sea Grant: 804/684-7165, *mike@vims.edu*
Michael Schwarz, Virginia Sea Grant: 757/727-4861, *mschwarz@vt.edu*

The **26th Annual International Submerged Lands Management Conference** is scheduled for October 28 – November 7, 2007 in Williamsburg, Virginia. The conference will spotlight issues surrounding the administration of submerged lands and adjacent uplands. Conference sessions will focus upon the opportunities, successes and challenges facing managers of submerged lands and resources. State and provincial managers and other specialists who deal with issues pertaining to the administration of submerged lands and adjacent uplands are encouraged to attend.

The conference is hosted by the Virginia Marine Resources Commission with sponsorship from Virginia Sea Grant and The Nature Conservancy. Full conference registration is $350 before September 28. Registration and additional conference information is available on the conference Web site at *www.submergedlands2007.com*.

For further information, contact Tony Watkinson, Virginia Marine Resources Commission, 757/247-2255 or *Tony.Watkinson@mrc.virginia.gov*.



Courtesy: U.S. Fish and Wildlife Service/ Karen Couch

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